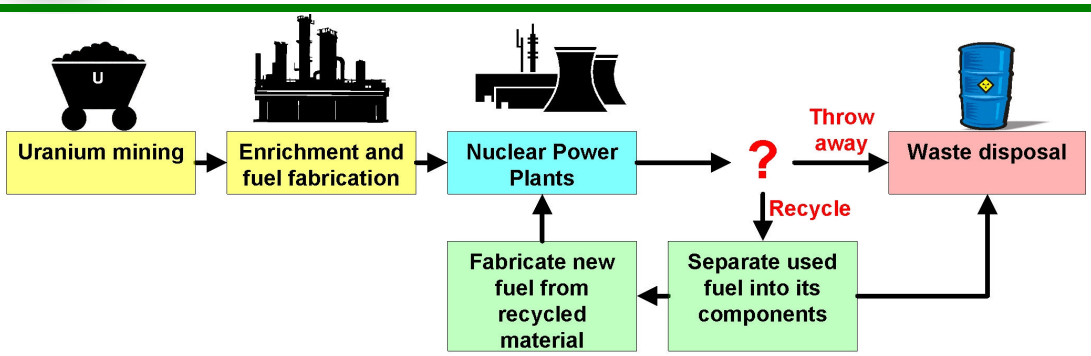
What is a nuclear fuel cycle?



A "fuel cycle" describes where the sources of fuel come from and where waste goes

The fuel cycle starts with mining and refining uranium ore. Generally, the uranium must be "enriched" in the uranium isotope 235, which splits or *fissions* more easily than the other natural uranium isotopes. The enriched uranium is made into fuel, then used in a nuclear power plant. Used fuel that comes out of a power plant is only partially consumed. It has three major components: uranium, *transuranic elements*, and fission products. See the fact sheet on "*Why recycle used nuclear fuel*" for more discussion of these components.

The two strategies for used fuel are to dispose of the used fuel as waste (throw away) or to separate and recycle uranium and transuranic elements from the waste fission products.

Throw away

In the "throw away" fuel cycle, also called "once through," fuel goes through a nuclear power plant once, and is then thrown away. This is also called the "open cycle."

This is the simplest fuel cycle; no separation plants are needed. No fabrication of recycled material is needed. The U.S. and many other countries use this approach.

Recycle

In recycle approaches, some of the used fuel is cycled back into new fuel. This is also called a "closed cycle." France, the United Kingdom, and other countries use this approach. There are several issues.

One issue is which materials are recycled and which are waste. In all cases, the fission products are waste. In the GNEP, all of the *transuranic elements* are recycled, which minimizes the long-term hazard of the residual waste. Used uranium is separated; some may be used in new fuel. The rest is stored for possible future use in yet more advanced nuclear power plants. It is more important to recycle transuranics than used uranium because the transuranics contain relatively more energy (per mass), are more toxic and pose a potential weapons proliferation risk.

Another issue is which types of nuclear power plants are used. There are two main types. Thermal reactors typically use "enriched" uranium for fuel. Virtually all of today's power plants are thermal, such as the Light Water Reactors used in the U.S. The other type, *fast reactors*, can extract energy from all types of uranium, including depleted uranium, which is otherwise waste from enrichment, and all isotopes of the transuranic elements. The GNEP includes development of a new fast reactor, the *Advanced Burner Reactor*, designed as a highly efficient "consumer" of transuranic elements.

A final issue is which chemical separation technology is used to separate useful material in used fuel from residual waste. See the fact sheet on *advanced fuel separation technology*.

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